1,086,005

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,086,005

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COMPLETE SPECIFICATION

Mounting Arrangements for Electronic Devices

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, a British Company having its registered office at 33 Grosvenor Place, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a mounting arrangement for electronic devices and in particular to an insert for location between the electrically conductive outer casing of the device and a metal support for the device.

Electronic devices, particularly semi-conductor devices may have an outer casing at least part of which is of electrically conductive material, and when the device is required to be mounted on a mounting structure or support which constitutes, or at least forms part of a heat sink for the dissipation of heat generated by the device during its operation, it is necessary to ensure that the casing of the device is electrically insulated from the support. Furthermore, any electrically insulating means positioned between the electronic device and the support thereof to provide the electrical insulation needs to have good thermal conductivity. The insulating means may, for example, take the form of an electrical insulator comprising a disc of sintered beryllia insulators which are very brittle, it is not always possible to obtain sufficiently flat and even surfaces to avoid the tendency of these insulators to fracture when they are clamped between the casing of the electronic device and the support. This tendency to fracture results from bending stresses acting on the insulator due to its uneven surfaces and the setting up of the bending stresses can only be avoided by providing the requisite degree of flatness or evenness on the beryllia by machining. Machining of beryllia is an extremely expensive process, particularly where the surface to be machined is of considerable area, as would be the case of a beryllia insulator for mounting between a semi-conductor power rectifier say, and a metal support therefore.

According to the present invention, an insert suitable for location between the electrically conductive outer casing of an electronic device and a metal support for the device, comprises a body of resilient electrically insulating material having fragments of material of poor electrical and good thermal conductivity so embedded therein as to provide a plurality of electrically insulating thermally conductive paths between a surface of the body arranged to abut against the casing and a surface of the body arranged to abut against the support.

Since a plurality of fragments of material of poor electrical and good thermal conductivity are provided, the surfaces of these fragments which engage with the device or the support are necessarily smaller than the surfaces of a single piece of such material used as the insert between the device and the support. The smaller the surface area of each fragment of material the easier it is to machine that material, and the machining need not be so accurate since the danger of fracture of the material is not so prevalent since the resilient material serves to some extent to isolate the fragments from one another and readily accommodates any bending stresses set up in the insert when the device is clamped to the support with the insert disposed therebetween.

The fragments are preferably of sintered beryllia since this material has poor electrical and good thermal conductivity, but other materials such as alumina may be used, although the thermal characteristic, particularly of alumina is inferior to that of beryllia. The fragments may conveniently comprise transverse slices of a bar of the material, for example having an hexagonal transverse cross-section and these slices which are arranged to be of substantially the same thickness may be arranged in concentric rings with the opposite faces of the fragments co-planar with or stand-

[*Price 4s. 6d.*]

ing slightly proud of the corresponding faces of a plate of the resilient electrically insulating material.

The body of resilient material may be of silicone rubber, synthetic rubber or an epoxy resin.

To further reduce any small departures in the flatness of the surfaces of the fragments, a coating of deformable metal may be applied on the opposite surfaces of the plate of resilient material, said deformable metal taking up any differences in thickness or flatness of the fragments. The deformable metal may be arranged to extend over a limited central region of the opposite faces of the resilient material so as to leave a marginal area or areas of the disc uncoated. The metal employed should be electrochemically compatible with the metal of the casing of the electronic device and also of the support, which means to say that in the presence of moisture any potential difference produced between the contacting metal surfaces will be negligibly small. For example, the deformable metal may be of aluminium, tin or zinc when the casing of the electronic device and the support are of aluminium.

In order that the invention may be more readily understood it will now be described, by way of example, with reference to the accompanying drawing, in which:—

Fig. 1 is a side elevation of a semi conductor rectifier mounted on a heat sink with an insert in accordance with the present invention located therebetween;

Fig. 2 is a plan of the insert shown in Fig. 1;

Fig. 3 is a side elevation of a semi-conductor rectifier mounted on a heat sink with an insert in accordance with a further embodiment of the invention located therebetween; and

Fig. 4 is a plan of the insert shown in Fig. 3.

Referring to Figs. 1 and 3, a semi-conductor power rectifier is indicated by reference numeral 1. This electronic device comprises an outer casing 2, at least the base portion 3 of which is of an electrically conductive material, and a semi-conductor element (not shown) having a rectifying junction formed therein is located within the casing. The rectifier is provided with a top cap 4 which provides one terminal for the device, and the base portion 3 of the casing is connected electrically to the element and serves as the other terminal. A conductive strap 5 is connected to the base portion 3 of the casing to enable an electrical connection to be made thereto. During operation of the device considerable quantity of heat is developed and in order to dissipate the heat it is convenient to mount the device on a metal support 6 which serves as a heat sink for some of the heat developed. Particularly if two or more electronic devices are mounted on the same heat sink it is desirable to electrically insulate the casing of each device from the heat sink while at the same time allowing thermal energy to be passed from the casing to the heat sink.

The present invention provides an insert for the location between the conductive casing of the device and the heat sink, and in the embodiment of the invention illustrated in Figs. 1 and 2 the insert comprises a plate of resilient electrically insulating material 7 having a pair of substantially parallel opposite faces, one of which is arranged to abut against the base 3 of the casing, and the other arranged to abut against the metal support 6 when the insert is clamped between the device and the support. A plurality of fragments 8 of beryllia are embedded in the resilient electrically insulating material, but extend between the opposite faces of the plate so that substantially all of the fragments make contact with the base of the casing and the heat sink. The fragments are in the form of discs of circular cross-section and are arranged in concentric rings. The fragments may be spaced from each other or they may be arranged in a tight cluster, as shown in Fig. 2, with at least some of the fragments touching those fragments adjacent thereto. The electrically insulating material from which the plate is formed forms a bond around each fragment and by providing the plate with an integral upstanding rim 9 extending substantially parallel to the side walls of the base portion 3 of the casing, the length of the electrical creep path between the casing and the heat sink is increased.

The insert shown in Figs. 3 and 4 is in the form of a flat disc, and the fragments 8¹ are of hexagonal cross-section and are embedded in spaced relation in the electrically insulating material from which the plate is constituted. The insert is not provided in this case with an upstanding rim and to increase the length of the electrical creep path between the casing of the device and the heat sink a continuous groove 10 may be formed in the surface of the heat sink with the insert and the device mounted on the central portion of the heat sink surrounded by the groove.

The manner in which the semi-conductor device is clamped to the heat sink is not shown, since any conventional means which preserves the electrical insulation between the semi-conductor device and the mounting structure may be employed.

In an alternative embodiment of the invention, not illustrated, an insert may comprise a plate of electrically insulating material thicker than those shown in the accompanying drawing, and at least some of the electrically insulating thermally conductive paths between the opposite faces of the plate are provided by more than one fragment. For example, two fragments may be embedded in the plate in overlapping relation so that one surface of one

fragment extends to a face of the plate while another surface of the fragment engages with a surface of the other fragment which in turn provides a surface on the other face of the plate. In this way heat from the casing of the device flows through one fragment into the other and then to the heat sink.

In a still further embodiment the plate of resilient insulating material may have an upstanding rim which is not integral therewith. The material forming this rim may have mechanical or electrical properties superior to the resilient insulating material to which it is bonded.

Two or more inserts with their fragments in contacting relation may be positioned between the device and the heat sink.

WHAT WE CLAIM IS:—

1. An insert suitable for location between the electrically conductive outer casing of an electronic device and a metal support for the device, said insert comprising a body of resilient electrically insulating material having fragments of material of poor electrical and good thermal conductivity so embedded therein as to provide a plurality of electrically insulating thermally conductive paths between a surface of the body arranged to abut against said casing and a surface of the body arranged to abut against said support.

2. An insert as claimed in claim 1, wherein the body is in the form of a plate having a pair of substantially parallel opposite faces arranged to abut against the casing and the support respectively and with substantially all of said fragments extending between said faces.

3. An insert as claimed in claim 2, wherein each fragment is in the form of a disc, the opposite faces of which are co-planar with or stand slightly proud of the corresponding faces of the plate.

4. An insert as claimed in claim 3, wherein the discs are arranged in concentric rings.

5. An insert as claimed in claim 3 or 4, wherein each disc is hexagonal in plan.

6. An insert as claimed in any preceding claim, wherein the fragments are of sintered beryllia.

7. An insert as claimed in any of the Claims 1 to 5, wherein the fragments are of alumina.

8. An insert as claimed in any of the Claims 2 to 7, wherein said plate is of circular plan.

9. An insert as claimed in any of the Claims 2 to 8, wherein said plate has an upstanding rim.

10. An insert as claimed in any preceding Claim, wherein the body is of silicone rubber.

11. An insert as claimed in any preceding Claim, wherein a layer of deformable metal is provided on the surfaces of the body arranged to abut against the base and the support respectively.

12. An insert substantially as hereinbefore described with reference to Fig. 2 or Fig. 4 of the accompanying drawing.

13. The combination of an electronic device having an outer casing at least the base of which is electrically conductive, clamped to a metal support with a insert as claimed in any preceding claim located between the base of the device and the support to provide a plurality of electrically insulating thermally conductive paths between the base and the support.

14. The combination as claimed in Claim 13, in which the device is a semi-conductor rectifier one terminal of which is constituted by the base of the outer casing of the rectifier.

15. The combination as claimed in Claim 13, and substantially as hereinbefore described with reference to Fig. 1 or Fig. 2 of the accompanying drawing.

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1086003 COMPLETE SPECIFICATION

1 SHEET. This drawing is a reproduction of the Original on a reduced scale

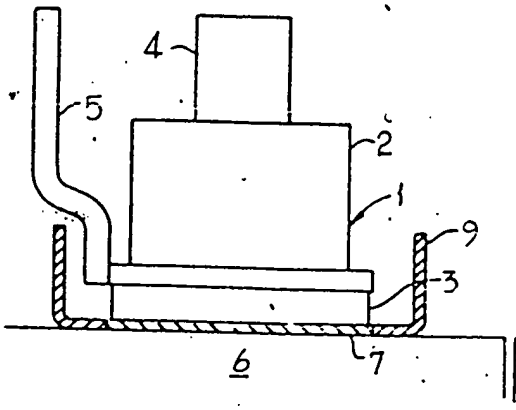

Fig.1.

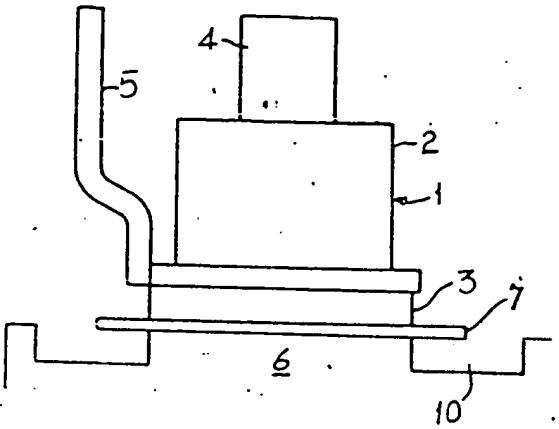

Fig.3

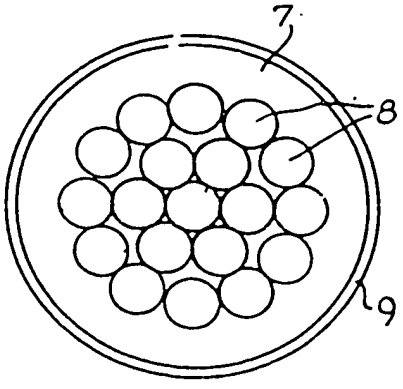

Fig.2.

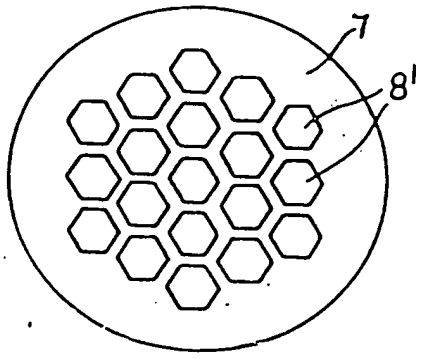

Fig.4.